

*INTERIM  
REPORT*

Interim Contractor Report #4

02/01/97 - 02/28/97

**Physics of Boundaries and their Interactions in Space Plasmas**

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## **I. Bow Shock & Foreshock:**

We are continuing our large scale hybrid simulations of the bow shock and have started experimenting with the implementation of a finite magnetic field in the obstacle. In addition, as part of an effort to make our research results readily available to our colleagues and to the general public, we are continuing our development of a web site which will contain various tools for "looking" at our data. We are planning on offering a great deal of interactivity to our site so that individuals can perform their own analysis of data, etc.. We have experimented with several techniques of accomplishing this and are in the process of evaluating the various methods.

## **II. Kelvin-Helmholtz Instability at the Magnetopause and the Magnetotail:**

We made a large run using our latest version of the 3-D hybrid code which runs on the parallel machine CRAY T3D. These simulations are out of reach of serial machines and it took the massively parallel CRAY T3D (512 processors) to make them a reality. These kinetic simulations include, for the first time, the simultaneous growth and development of the tearing and Kelvin-Helmholtz instabilities. We have also started work on the linear kinetic theory of the Kelvin-Helmholtz instability at the magnetopause. This theory will allow for an arbitrary profile of density and magnetic field. This is important in order to study the effect of asymmetries in density and magnetic field that are present at the magnetopause on the growth of the instability. We have also written up the first draft of our research results on the 3-D kinetic instability of the magnetopause which incorporates both tearing and KH instabilities.

## **III. Large-Scale Hybrid Simulations of the Magnetotail:**

We are continuing our study of the near-Earth reconnection and its consequences. As part of this work, we are arranging for further collaboration with the space physics group in Umea, Sweden. Currently, we are discussing the role of ionospheric oxygen ions in the near tail, and are preparing for joint work on this topic for the upcoming IAGA meeting in Uppsala, Sweden.

## **IV. Meeting:**

We prepared and presented three invited talks at the International Workshop on Nonlinear Waves and Turbulence in Space Plasmas, held in Cologne, Germany. The three topics were (1) Linear theory and hybrid simulations retaining full ion kinetic effects, (2) The bow shock and magnetosheath turbulence, and (3) Wave generation and the evolution of pickup ion distributions at comets. This meeting gave us the opportunity to present our latest simulations techniques and results.



# REPORT DOCUMENTATION PAGE

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This report describes the work done by SciberNet, Inc. during the month of February. We continued our efforts in making our latest research results on the physics of earth's bow shock available online (internet). We have explored the viability of various techniques (e.g., Java, Javascript) in order to allow for interactive operations at the site. We also further refined our algorithm for the 3-D hybrid code which runs on the parallel machine T3D. We made a large run using this algorithm to examine the 3-D kinetic stability of the magnetopause and finished the first draft of a paper on this subject. Finally, we prepared and presented three invited talks at the International Workshop on Nonlinear Waves and Turbulence in Space Plasmas in Cologne, Germany.

Foreshock, bow shock, magnetotail, reconnection, kinetic simulations

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